

Aeolus Level-2B HLOS wind product quality report

Period: For the month up to 12 November 2020

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Introduction

An introduction to the Aeolus Level-2B wind monitoring statistics is provided on the Aeolus CAL/VAL webpage (under L2B Data Quality Handbook), for those that have access. The ECWMF Technical Memorandum 864 (Section 2.3) provides information on how the Aeolus O-B departure statistics are calculated; it is available here:

<https://www.ecmwf.int/en/elibrary/19538-nwp-impact-aeolus-level-2b-winds-ecmwf>

Daily updated, automatically produced statistics of observation minus background (O-B) and observation minus analysis (O-A) are available from the following website (from which many of the plots used in this report have been taken):

<https://www.ecmwf.int/en/forecasts/charts/obstat/?facets=Data%20type,Aeolus%20HLOS%20Wind>

Quality Control is applied to the ECMWF automated statistics, which consists of:

- Rejecting observations with Level-2B processor estimated instrument error beyond a threshold. $\sigma_O > 12$ m/s for the Rayleigh and $\sigma_O > 5$ m/s for the Mie.
- Rejecting observations when the Level-2B HLOS wind result overall confidence flag is invalid.
- A model based first-guess check i.e. reject if first-guess departure is deemed to be too large, indicating gross errors i.e. $O - B > 5 \sqrt{\sigma_O^2 + \sigma_B^2}$

1. L2B Rayleigh-clear O-B and O-A departure statistics

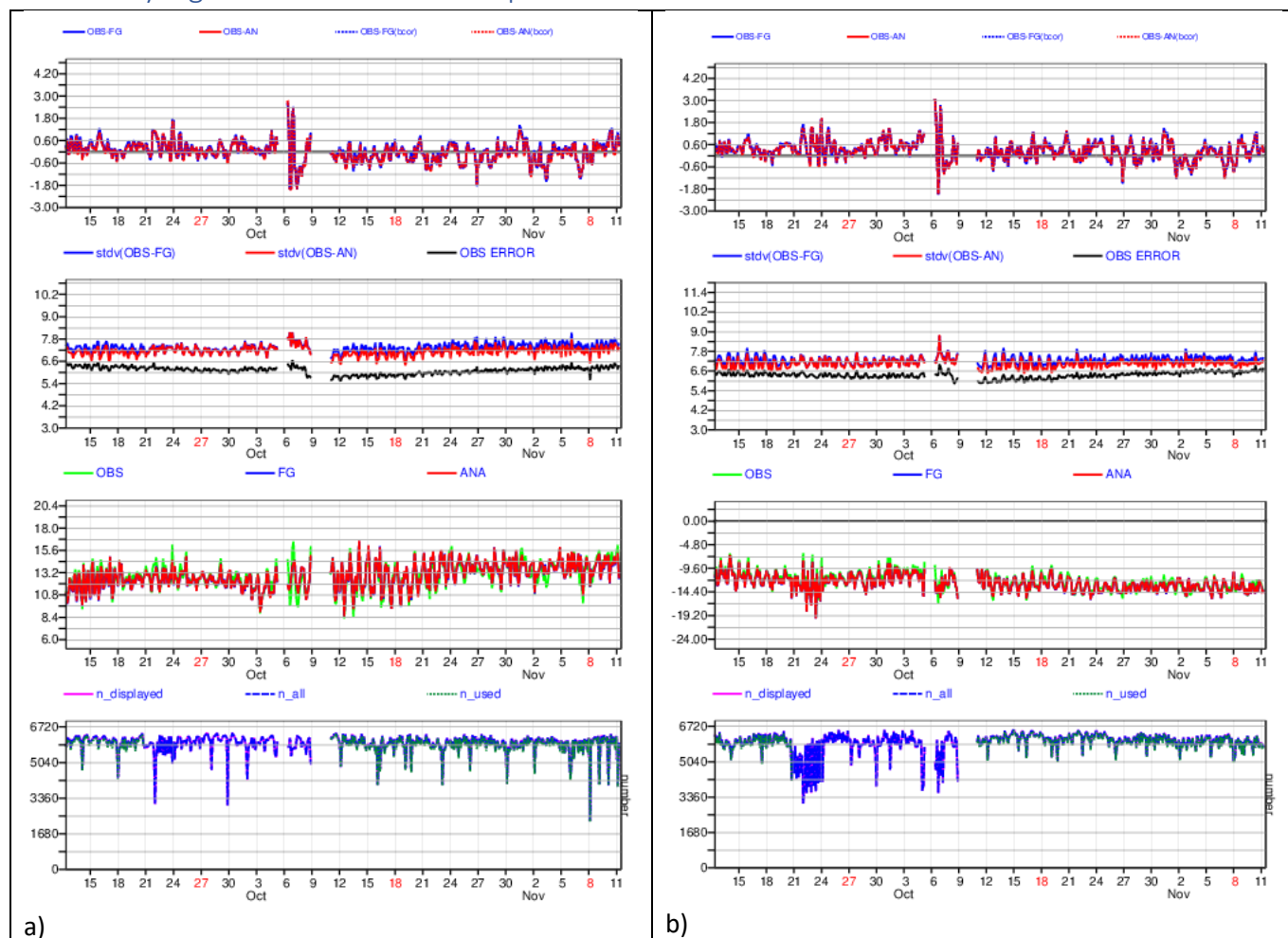


Figure 1. This figure shows changes with time in the O-B and O-A departure statistics of the L2B Rayleigh-clear winds with respect to the ECMWF model. The statistics are calculated every 3 hours for the 0-400 hPa pressure range. Panel a) is for ascending and panel b) is for descending orbit phase. The top plot is the mean of departures i.e. bias; the second plot down is the standard deviation of departures and the assigned observation error in data assimilation (OBS ERROR) i.e. information on random error; the third plot down is the mean observation value and mean model equivalent and the bottom plot is the number of observations per sample.

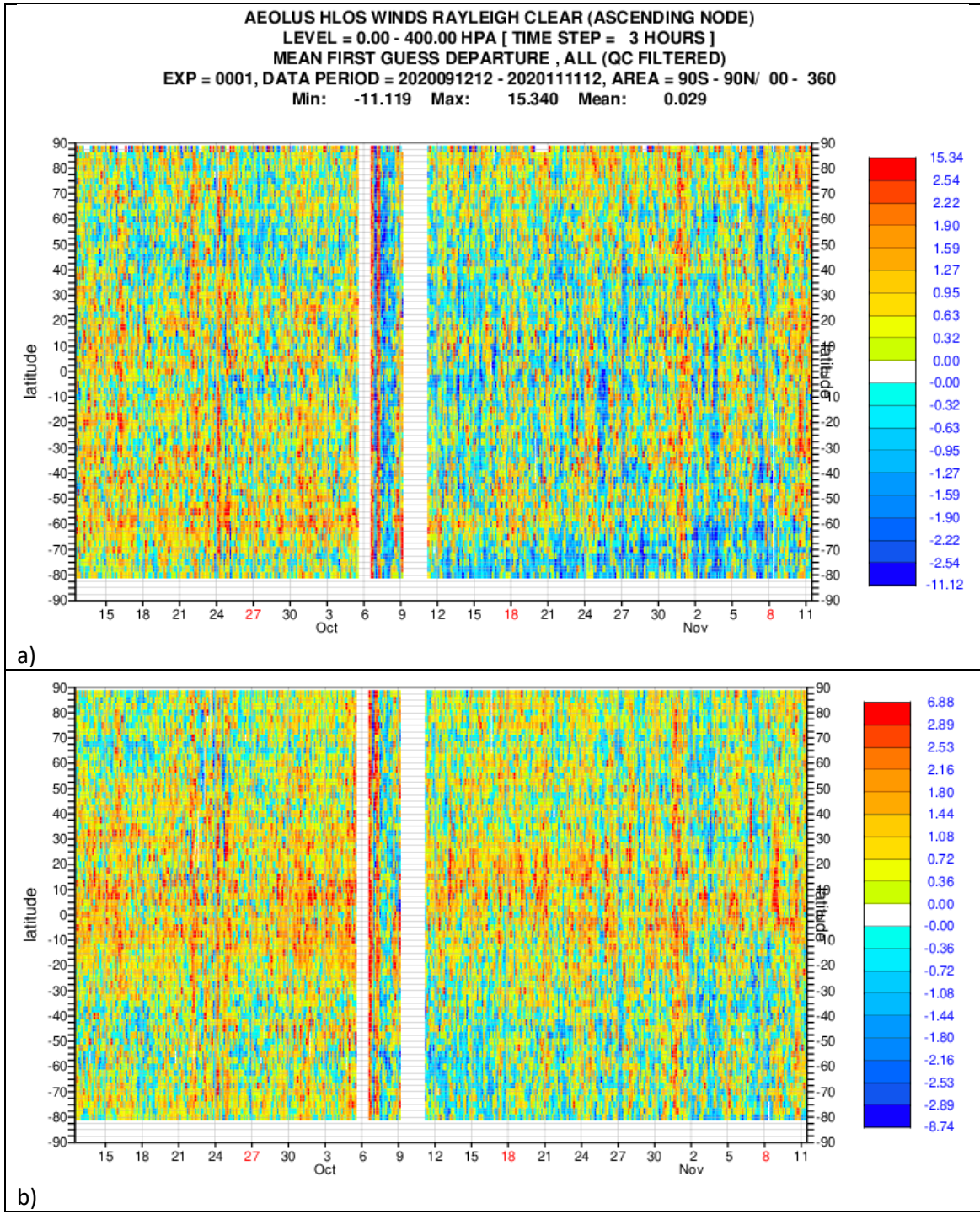


Figure 2. Latitude-time dependence of the mean(O-B) for L2B Rayleigh-clear HLOS winds for the 0-400 hPa pressure range for a) ascending and b) descending orbit phase. Unit: m/s.

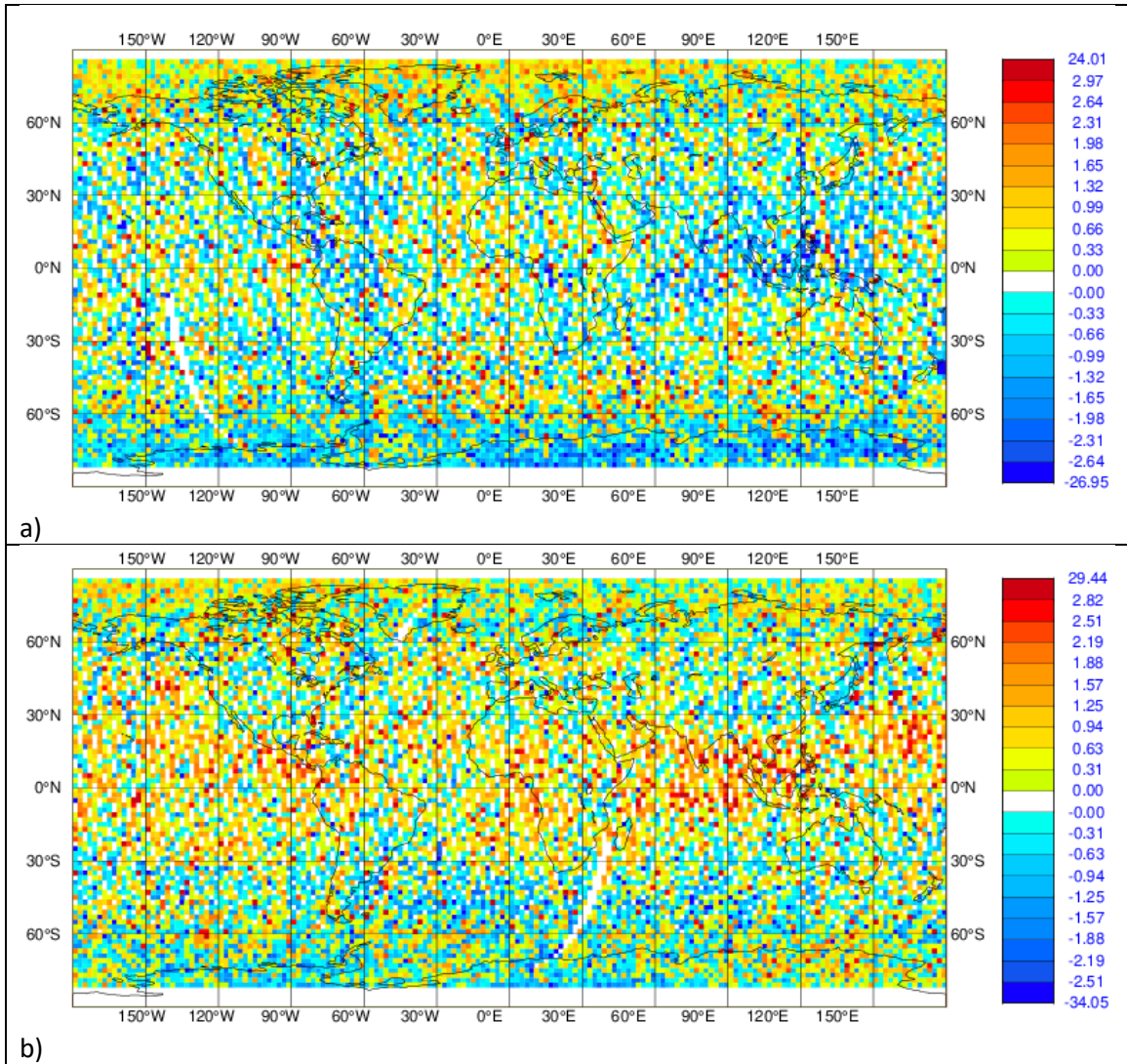
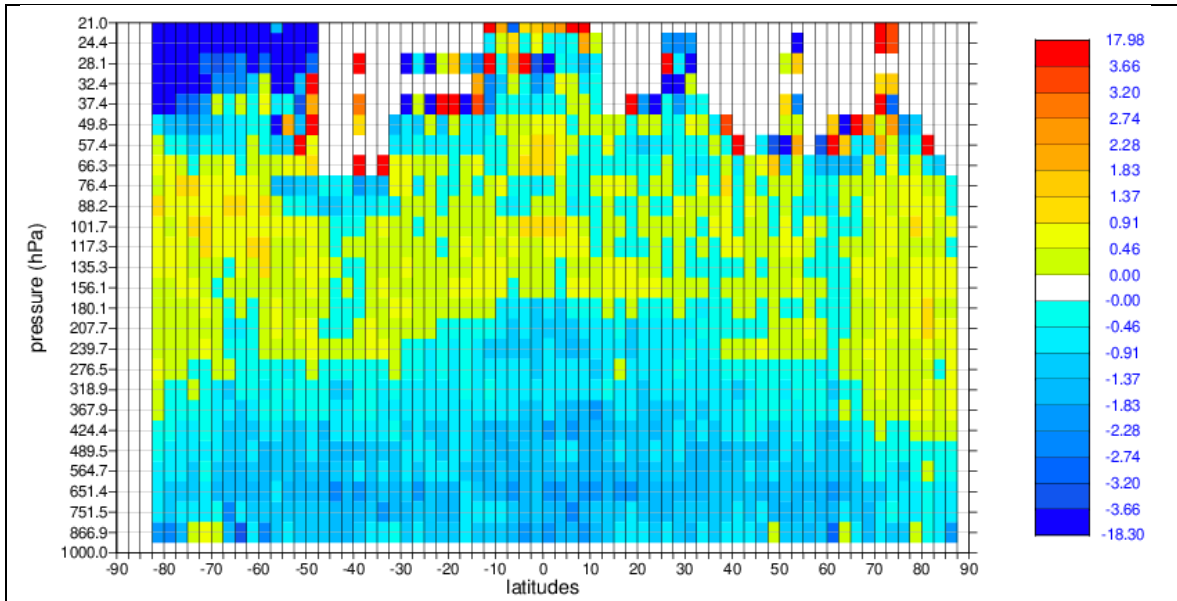
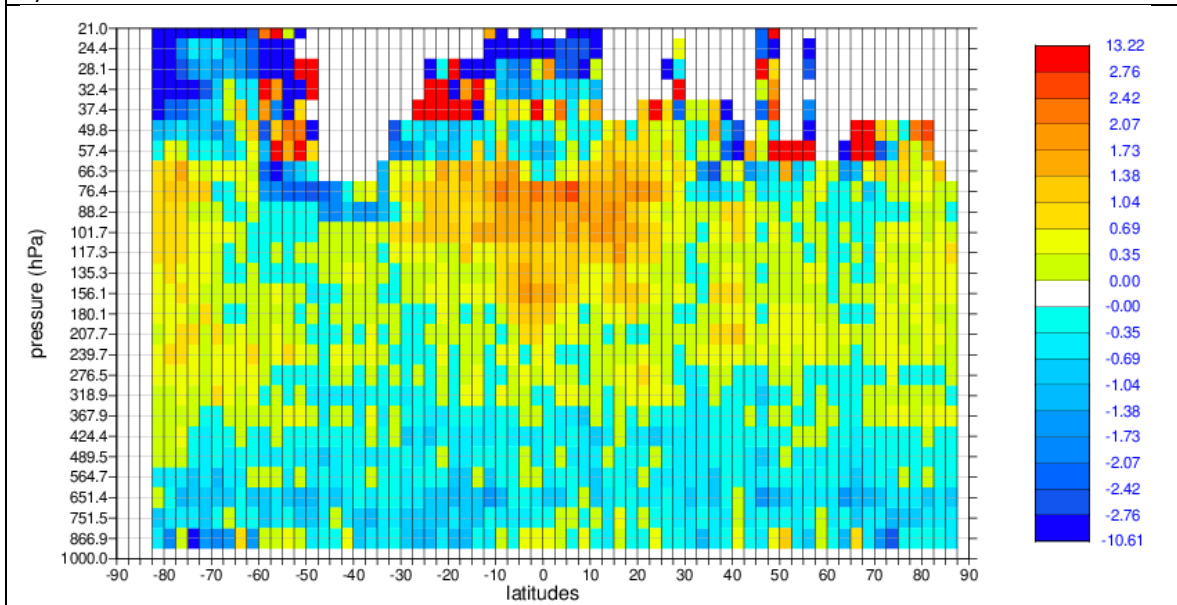


Figure 3. Maps of L2B Rayleigh-clear mean(O-B) for the 0-400 hPa pressure range for a) ascending and b) descending orbit phases. Unit: m/s. For the period: 13 October 2020 to 7 November 2020.



a)



b)

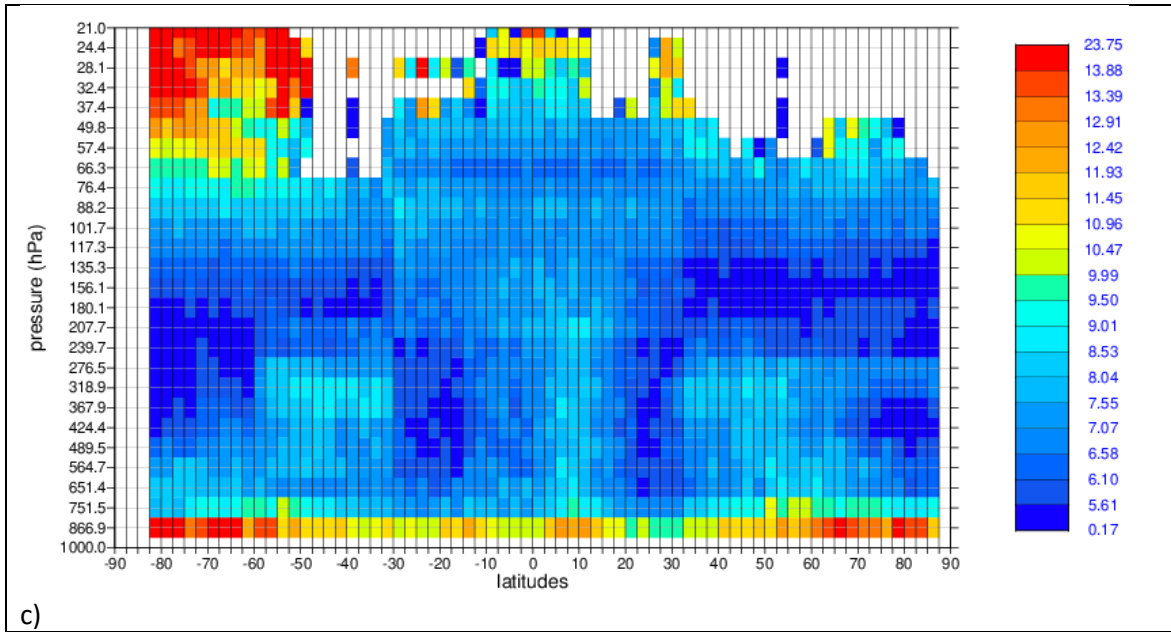


Figure 4. Pressure versus latitude dependence of the L2B Rayleigh-clear mean(O-B) for a) ascending and b) descending orbits. Panel c) is the standard deviation of (O-B) for ascending orbits. Unit: m/s. For the period: 18 October 2020 to 7 November 2020.

5

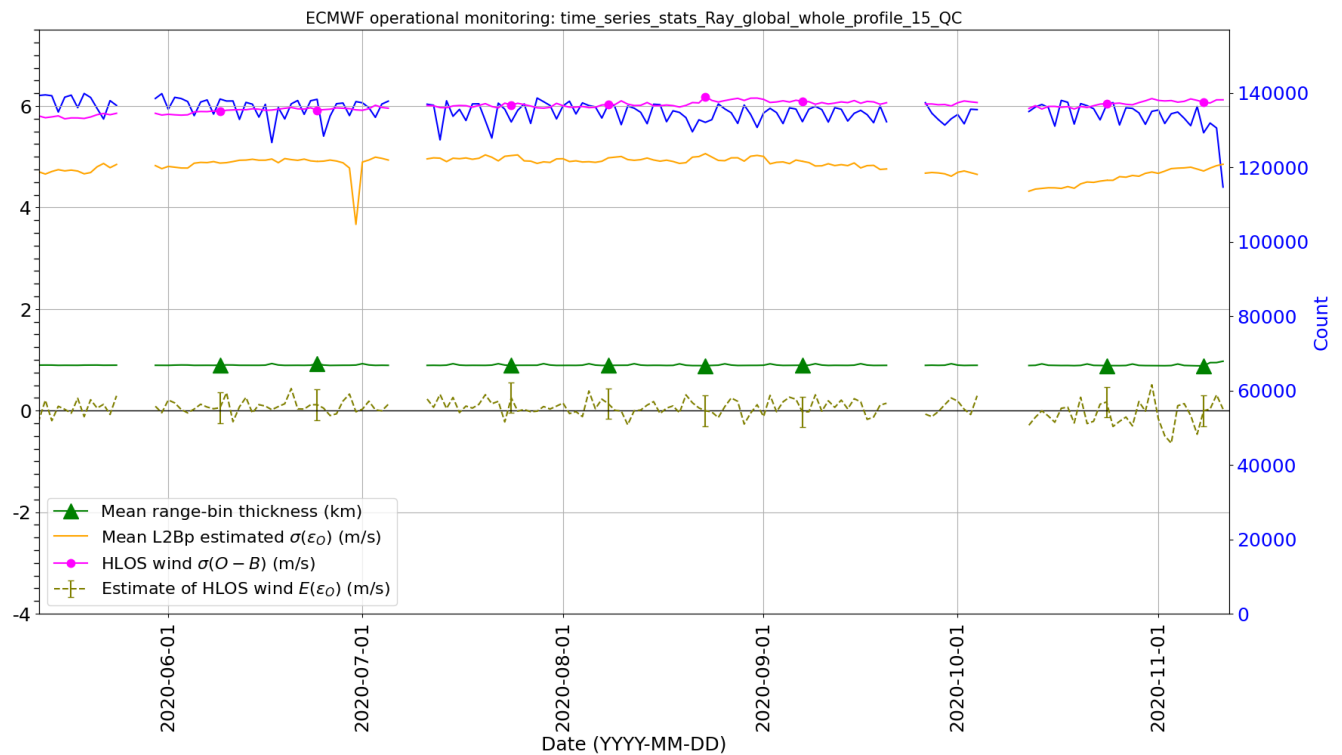


Figure 5. Times-series of daily global, whole profile L2B Rayleigh-clear HLOS wind related statistics for the recent period. QC for this type of plot is to reject winds if $abs(O-B) > 15$ m/s.

Comments and assessment of L2B Rayleigh-clear winds for this period:

- ALADIN laser sensitivity test sequence 2 (Special Operations Request) took place from 5-7 October 2020. This caused some temporary worsening of random error and bias.

- New processors (Baseline 11 (2B11)) came into operations on 8 October 2020, however this was immediately followed by laser sensitivity test sequence 3 from the 8-10 October 2020. The ability to set all winds invalid (overall validity flag) via the AUX_PAR_2B (an option with baseline 11) was implemented, leading to a gap in the data.
- When the data came back after sequence 3, the random errors were slightly improved with the new baseline due to some refinements in the L2B processor settings and inputs (in particular better classification of clear/cloudy air).
- The random error has increased over the past few weeks, which is a combination of increasing global average solar background noise and the continuing decrease in atmospheric path useful signal (DLR confirmed this).
- The Hovmöller type bias plots show that the M1 mirror temperature bias correction has not been performing as well as it should have recently, with various vertical stripes (meaning global offset bias affecting all latitudes). This is being investigated, but it is currently thought to be a seasonal effect (worse in Autumn). We should also try to rule out moon-blinding events.
- Positive bias continues to persist in the tropical upper troposphere for descending orbits. It is unclear what is causing this. It may be an ECMWF model issue e.g. errors associated with convection.
- Overall, the zonal average bias shows some similarities for ascending and descending orbits, with a generally negative bias at lower altitudes (higher pressures) and more positive bias at higher altitudes, except for the Southern high latitudes for which there is strong negative bias above 30 hPa. There are indications in offline testing that this related to the Rayleigh response calibration curves as a function of atmospheric temperature (Rayleigh-Brillouin Correction) being not quite right - this will hopefully be improved in the upcoming months.

2. L2B Mie-cloudy O-B and O-A departure statistics

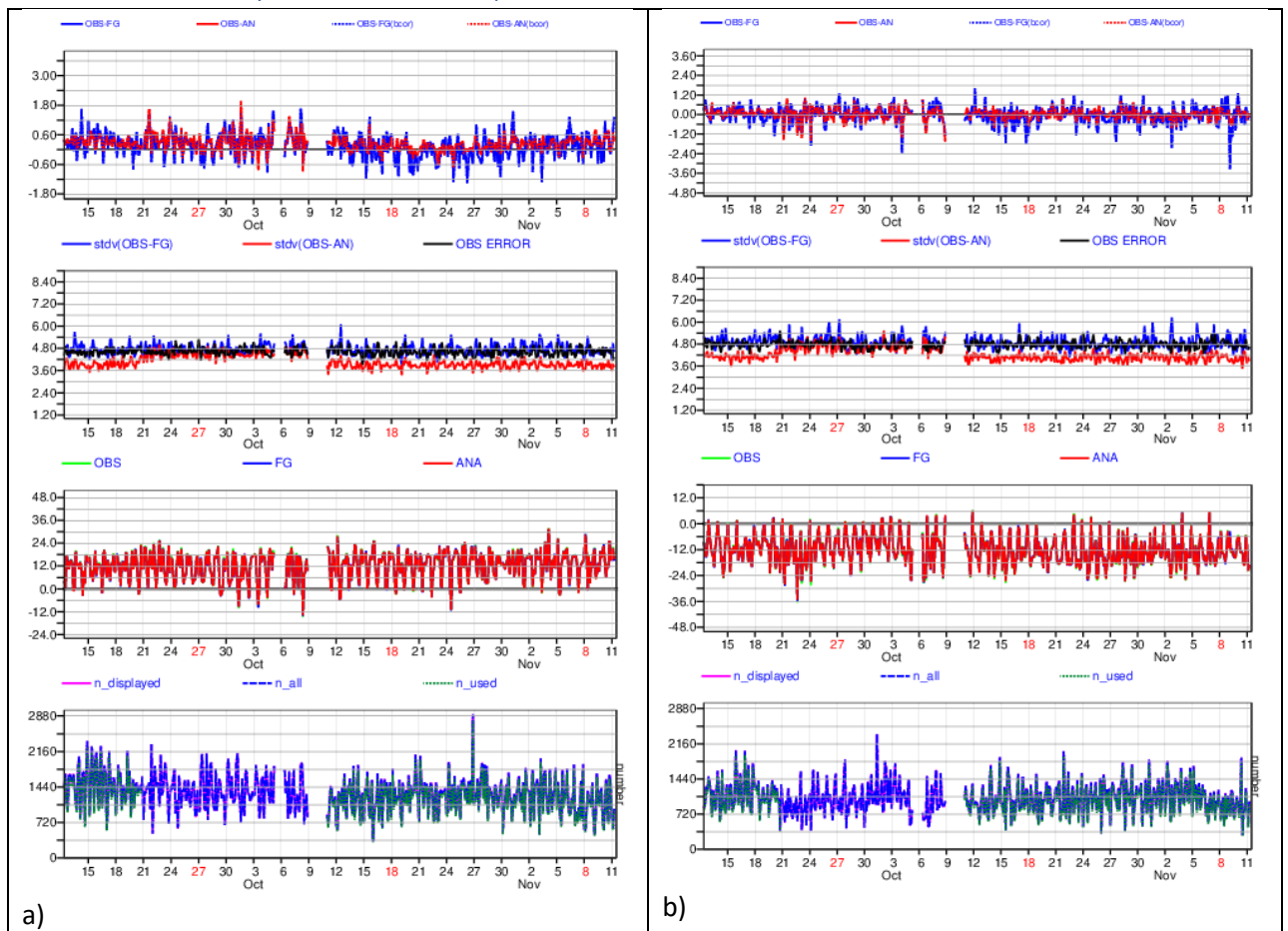
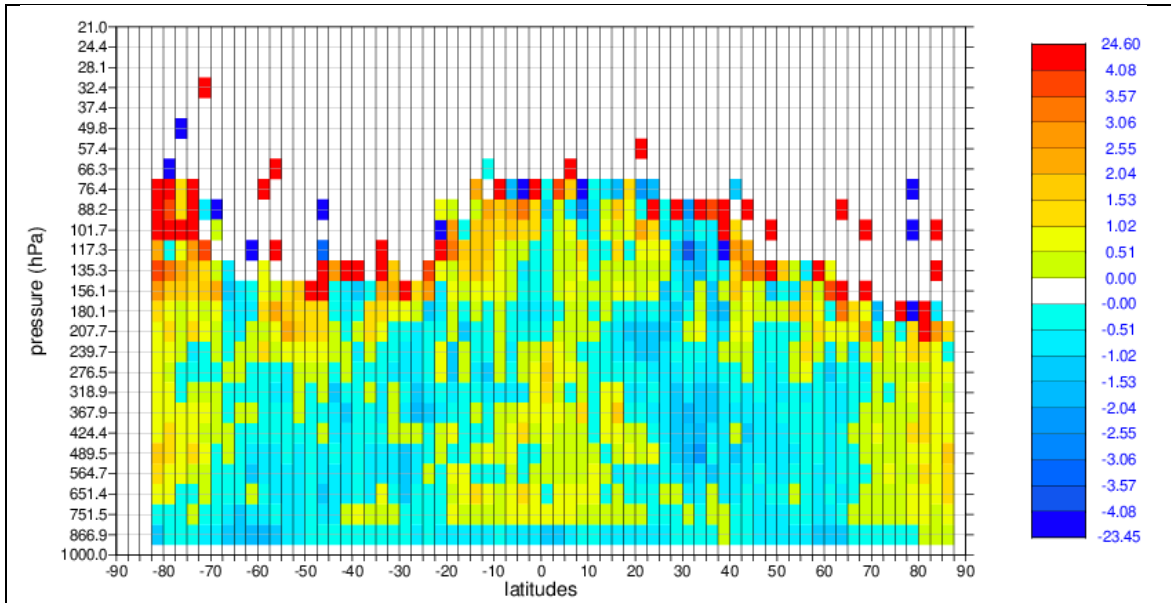
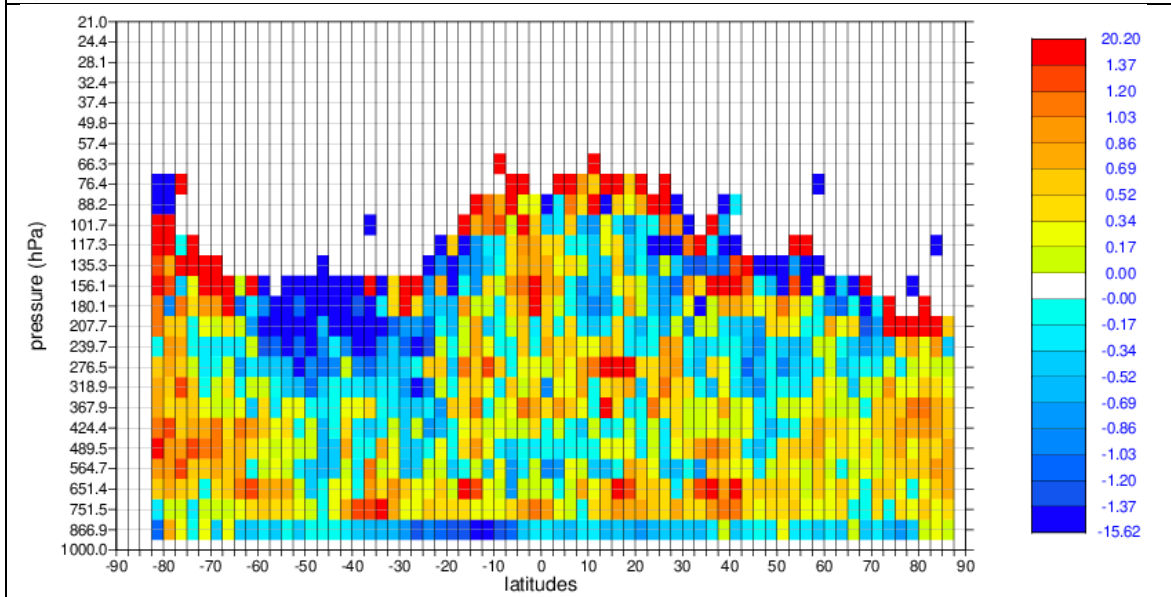


Figure 6. Same type of plots as in Figure 1, but for L2B Mie-cloudy HLOS winds.

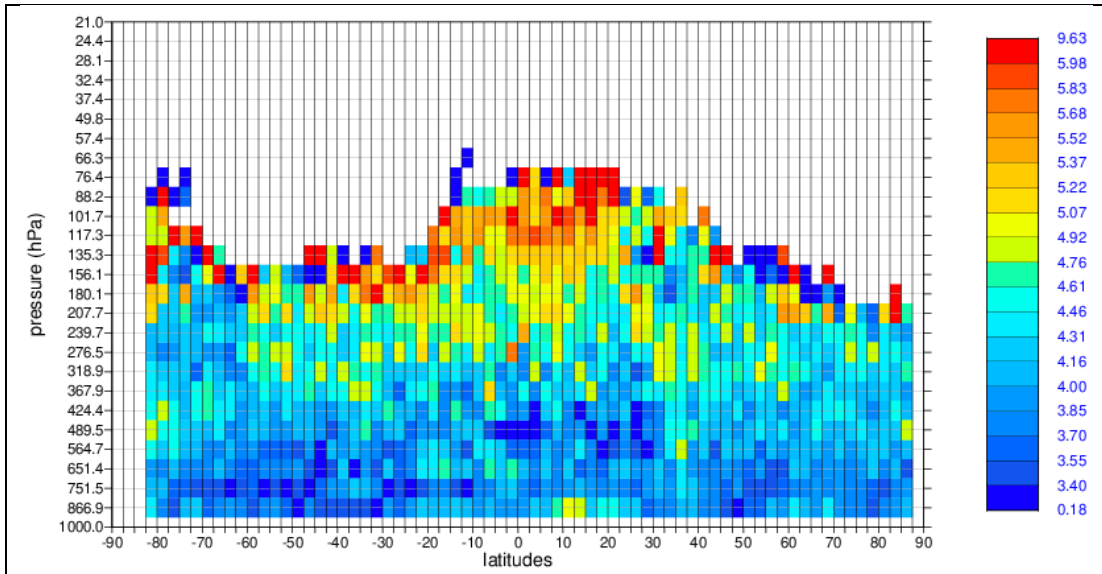


a)

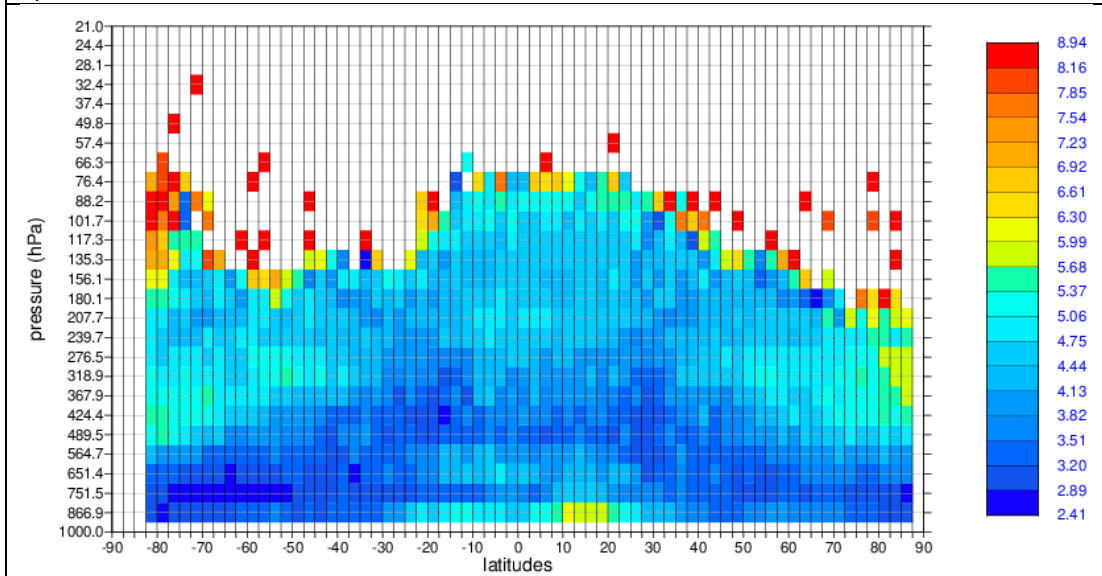


b)

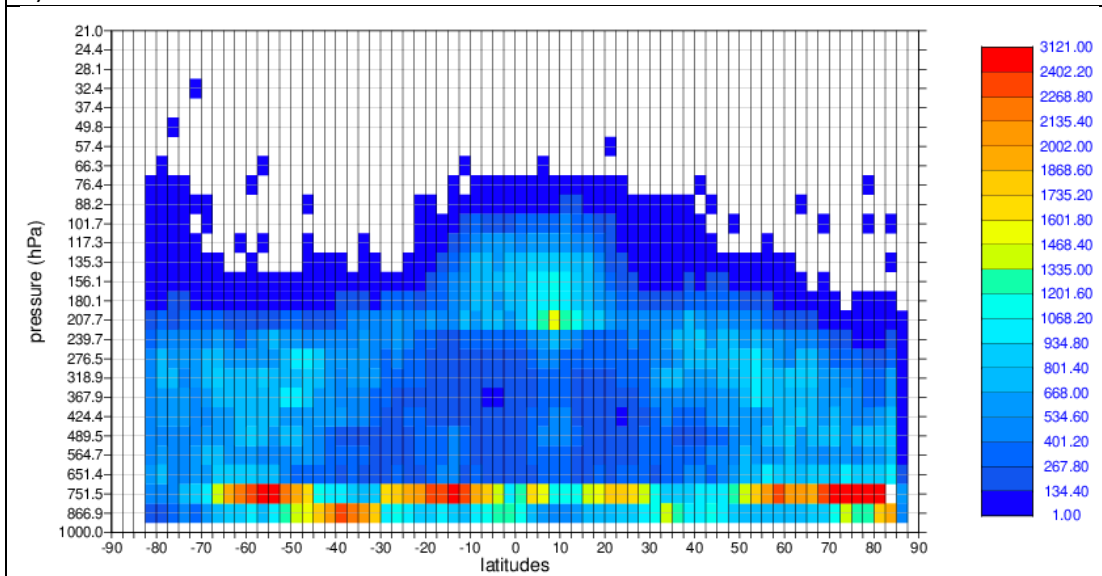
Figure 7. Pressure versus latitude dependence of the L2B Mie-cloudy mean(O-B) for a) ascending and b) descending orbits. Unit: m/s. For the period: 18 October 2020 to 7 November 2020.



a)



b)



c)

Figure 8. Pressure versus latitude dependence of the L2B Mie-cloudy a) ascending stdev(O-B) m/s, b) corresponding L2Bp estimated observation error m/s (scaled) and c) number of observations. For the period: 18 October 2020 to 7 November 2020.

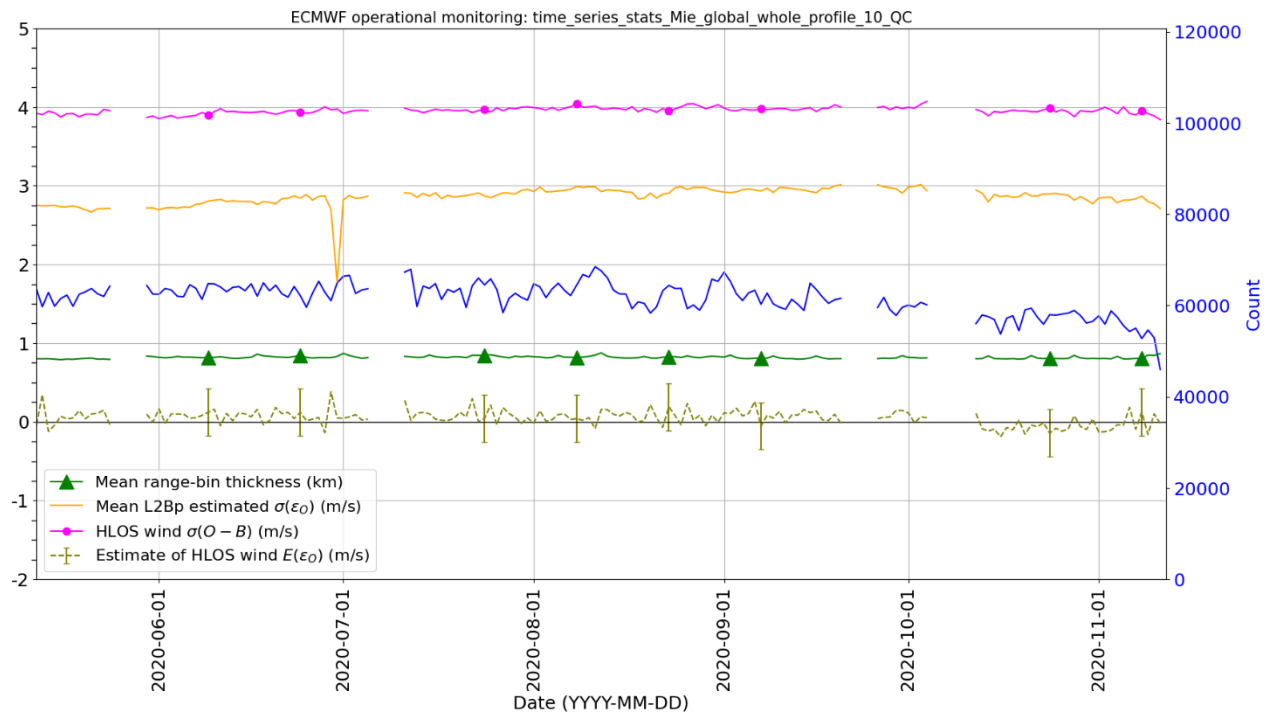


Figure 9. Times-series of daily, global, whole profile L2B Mie-cloudy HLOS wind related statistics for the recent period. QC for this type of plot is to reject if $abs(O-B) > 10$ m/s.

Comments and assessment of on L2B Mie-cloudy winds for this period:

- See the Rayleigh-clear comments regarding laser sensitivity tests and new processor baseline.
- Global average random error looks reasonably steady in the past month.
- The zonal average biases continue to have a complex pattern and change between ascending and descending orbits (although the magnitude is not that large i.e. ± 2 m/s). It is unclear if these are Aeolus or model wind biases (probably a mix of both).
- The high altitude Antarctic Mie winds are gradually reducing (compared to previous months) as the Polar Stratospheric Cloud coverage reduces as the polar vortex reduces in strength.
- Should check if the decrease in observation count with time is related to decrease in PSC winds, or if there needs a retuning of the Mie core algorithm QC thresholds.